Shiny Metals and Non-contact Infrared Temperature Measurements

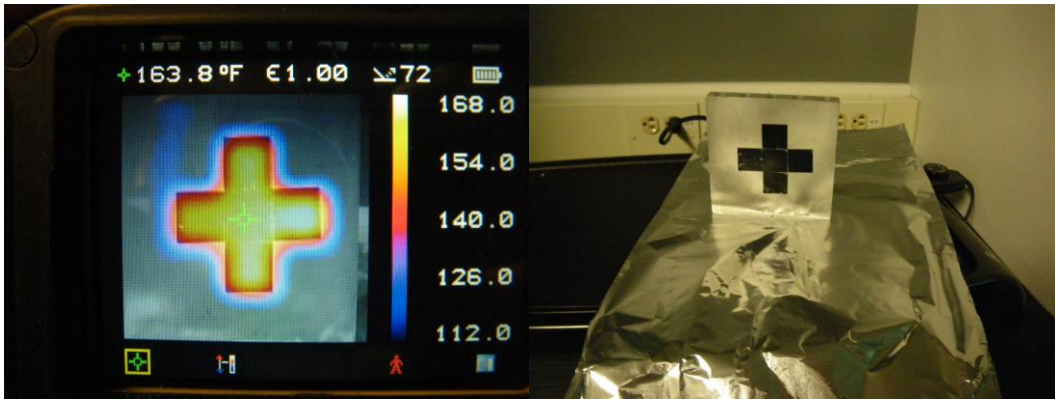
By
Joe DeMonte
ASNT/PdM Thermal Infrared Level III

Using infrared devices for non-contact temperature measurement may seem like an easy task. Just squeeze the trigger on the "laser pyrometer" and point it at the target for accurate temperatures, right? Wrong!! Different materials have different efficiencies at radiating. I will discuss briefly the important measures that must be taken to accurately measure temperatures with these devices.

Take a look at an aluminum block heated up on a hot plate. I am viewing this block heated by a hot plate with an infrared camera that detects the same radiation as a typical spot radiometer like an IDEAL Industries 61-685 or "laser Pyrometer". The infrared camera used in this paper is an IDEAL Industries 61-844 HeatSeeker™ and produces an infrared picture of the heat and allows me to obtain temperatures from hundreds of points across the thermal map.

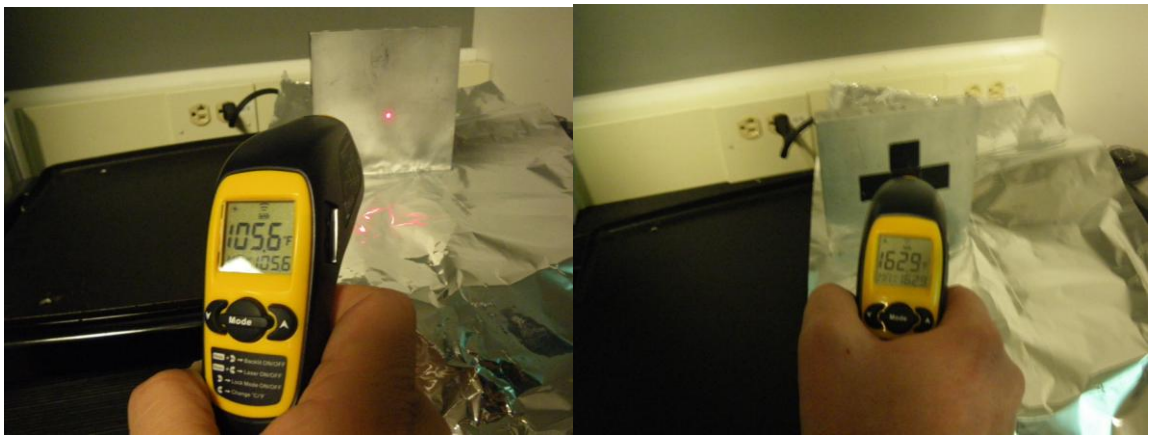
Al block heated on a hot plate.

In the next image, I have placed several pieces of black electrical tape on the surface of the aluminum block.



Temperature of theTape on the Al block

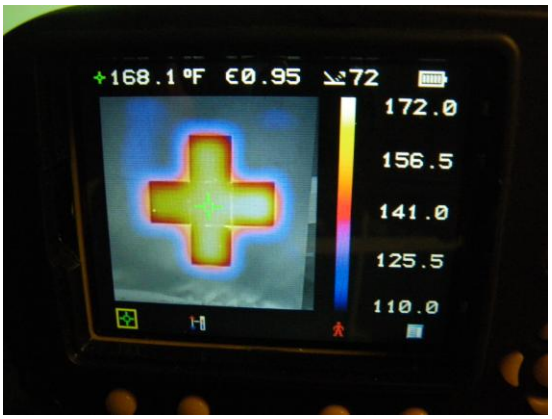
As you can see, the temperature of the block as read by an infrared device is nearly 60°F lower than that read on the tape! We would have the same results with a spot radiometer (assuming that the device was close enough for the distance to spot ratio).



Temperature on the block! Temperature on the tape!

It is not possible for the tape to actually be hotter than the block. The source of heat is at the bottom of the block and needs to conduct upwards through the aluminum and then out ward through the tape. What we are seeing is the difference in the efficiency of both the aluminum and tape to emit IR radiation. The actual value of this efficiency is from 0.0 to 1.0 and is termed emissivity. In all of the examples so far, we have not adjusted the emissivity of the HeatSeeker or the 61-685 spot radiometer. The tape has an average emissivity of 0.95 for the wavelengths of my infrared camera (IDEAL Industries HeatSeeker). What impact will this have on my temperature accuracy?

Next, I will correct for emissivity using my infrared camera by setting it to 0.95 and take the same measurement of the tape.



Temperature with Emissivity Correction

Proper compensation for emissivity results in another correct temperature rise. We can now adjust the infrared camera to give us a better understanding of the aluminum temperature now that we know the actual temperature is 168°F, not 164°F or 107°F as previously thought.

There is much more to this than meets the eye, and the basic course that you can take from IDEAL Industries on infrared science/certification lasts for a full three days. We just have to remember that accurate temperatures on clean, unpainted, and uncoated metals are not easy with infrared devices. Take your temperature measurements from highly corroded metals, or from other higher emissivity targets and you will have less error in your reading.

IF YOU DON"T HAVE AN ACCURATE TEMPERATURE ON ONE OBJECT, YOU CANNOT GET AN ACCURATE DIFFERENCE IN TEMPERATURE BETWEEN TWO OBJECTS EVEN WHEN THE EMISSIVITY IS EQUAL BETWEEN THE TWO!!